## TAPE RECORDED MUSIC AUTOMATIC SELECTING IC (9 MUSIC SELECTION)

Unit in mm

The TC9167P is an IC for automatic music selection for tape recorders. This IC has the built-in intermusic detecting circuit, and the displaying decoder and the driver circuits, and is capable of composing the automatic music selecting function with a few component parts.

. Capable of CUE/MS of up to 9 preceding/succeeding musics.

. Desired musics are set by the step-up system by means of the UP key.

. Preset music number is displayed by 7-segment LED which is directly driven by the built-in decoder and driver.

. The built-in intermusic detection circuit allows direct input of AC signal.

. The auto-clear circuit prevents malfunction at time of power ON/OFF.

. Operating supply voltage : 3.0V ~ 6.0V

Lead pitch is 2.54 and tolerance is ±0.25 against theoretical center of each lead that is obtained on the basis of No.1 and No.16 leads.

JEDEC	—
TOSHIBA	3D16A-P
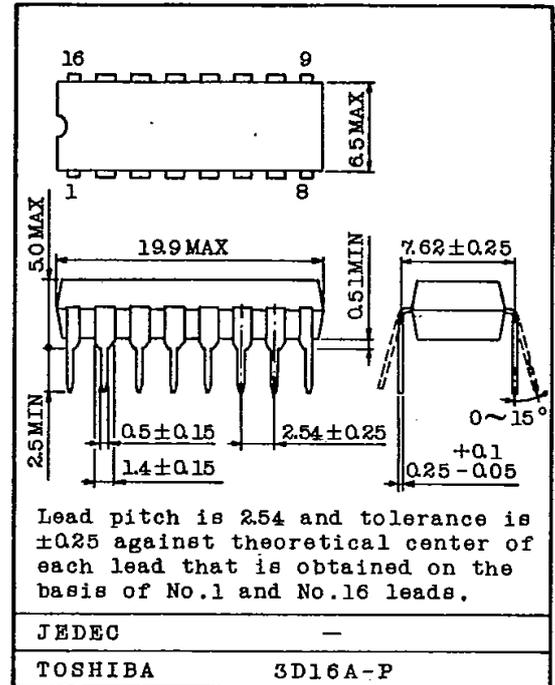
MAXIMUM RATINGS (Ta=25°C)

CHARACTERISTIC	SYMBOL	RATING	UNIT
Supply Voltage	V_{DD}	-0.3 ~ 7.0	V
Supply Current	I_{DD}	200	mA
Input Voltage	V_{IN}	-0.3 ~ V_{DD}+0.3	V
Output Current	I_{OH}	30	mA
Power Dissipation	P_D	300	mW
Operating Temperature	T_{opr}	-30 ~ 75	°C
Storage Temperature	T_{stg}	-55 ~ 125	°C

PIN CONNECTION

|		
GND	1	16	V_{DD}
OSC	2	15	A
AC-IN	3	14	B
DC-IN	4	13	C
OUT	5	12	D
EN	6	11	E
RESET	7	10	F
PRESET	8	9	G

AUDIO DIGITAL IC

TC9167P
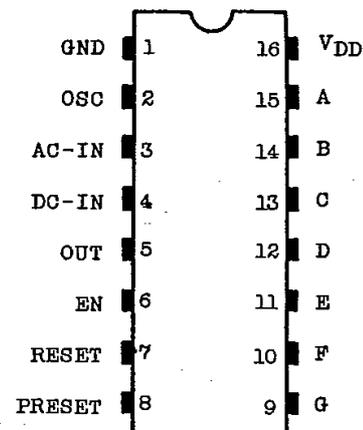
ELECTRICAL CHARACTERISTICS (Unless otherwise specified, V_{DD}=5.0V, Ta=25°C)

| CHARACTERISTIC		SYMBOL	TEST CIR-CUIT	TEST CONDITION		MIN.	TYP.	MAX.	UNIT
Operating Supply Voltage		V_{DD}	–			3.0	5.0	6.0	V
Operating Supply Current		I_{DD}	1	No Load f_{OSC}=200Hz		–	0.8	1.5	mA
Input Voltage	"L" Level	$V_{IL(1)}$	–	RESET, PRESET		0	–	$V_{DD} \times 0.3$	V
	"H" Level	$V_{IH(1)}$				$V_{DD} \times 0.7$	–	V_{DD}	
	"L" Level	$V_{IL(2)}$	–	DC-IN (Schmitt Input)		0	–	$V_{DD} \times 0.1$	
	"H" Level	$V_{IH(2)}$				$V_{DD} \times 0.9$	–	V_{DD}	
Output Current	"L" Level	I_{IL}		EN	V_{IL}=0V	–	–	1.0	μA
	"H" Level	I_{IH}			V_{IH}=5V	–	–	1.0	
Output Current		I_{OH}	2	OUT, A,B,C,D,E,F, G V_{OH}=4.0V		10	15	–	mA
Pull Up Resistance		R_{UP}	–	RESET, PRESET		–	47	–	$k\Omega$
Oscillation Frequency		f_{OSC}	–			DC	–	100k	Hz
Input Sensitivity		V_{IN}	4	f_{IN}=10kHz		50	100	200	mV_{rms}
Input Resistance		R_{IN}	–	AC-IN		–	470	–	$k\Omega$
Output Resistance		R_O	–	DC-IN		–	10	–	$k\Omega$
Auto Clear Voltage		V_{CL}	–			–	2.4	2.6	V

TEST CIRCUIT

1. I_{DD}
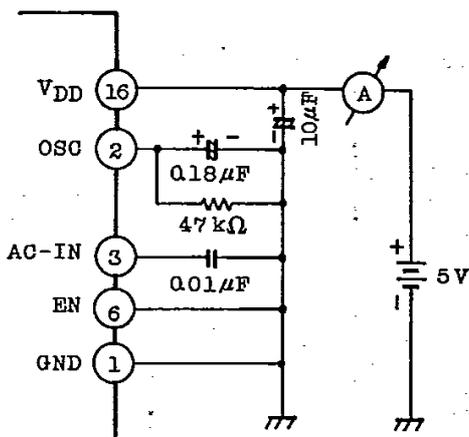
2. I_{OH}
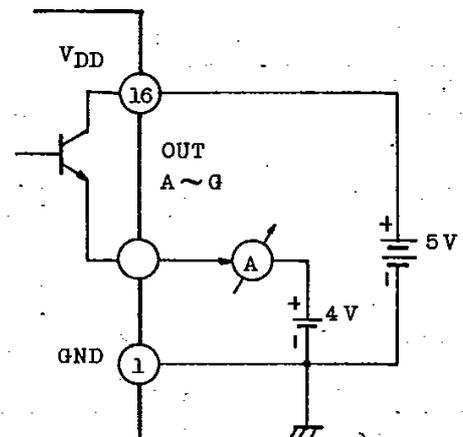
* Other pins than the above are all open.

TOSHIBA

3. V_{IN}
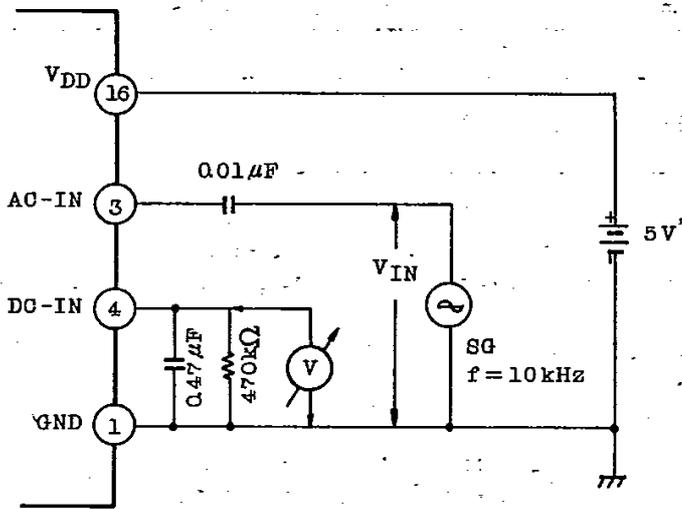
* An output value of SG when 4.5V is generated at DC-IN is denoted by V_{IN}.

* Other pins than the above are all open.

BLOCK DIAGRAM

TC9167P
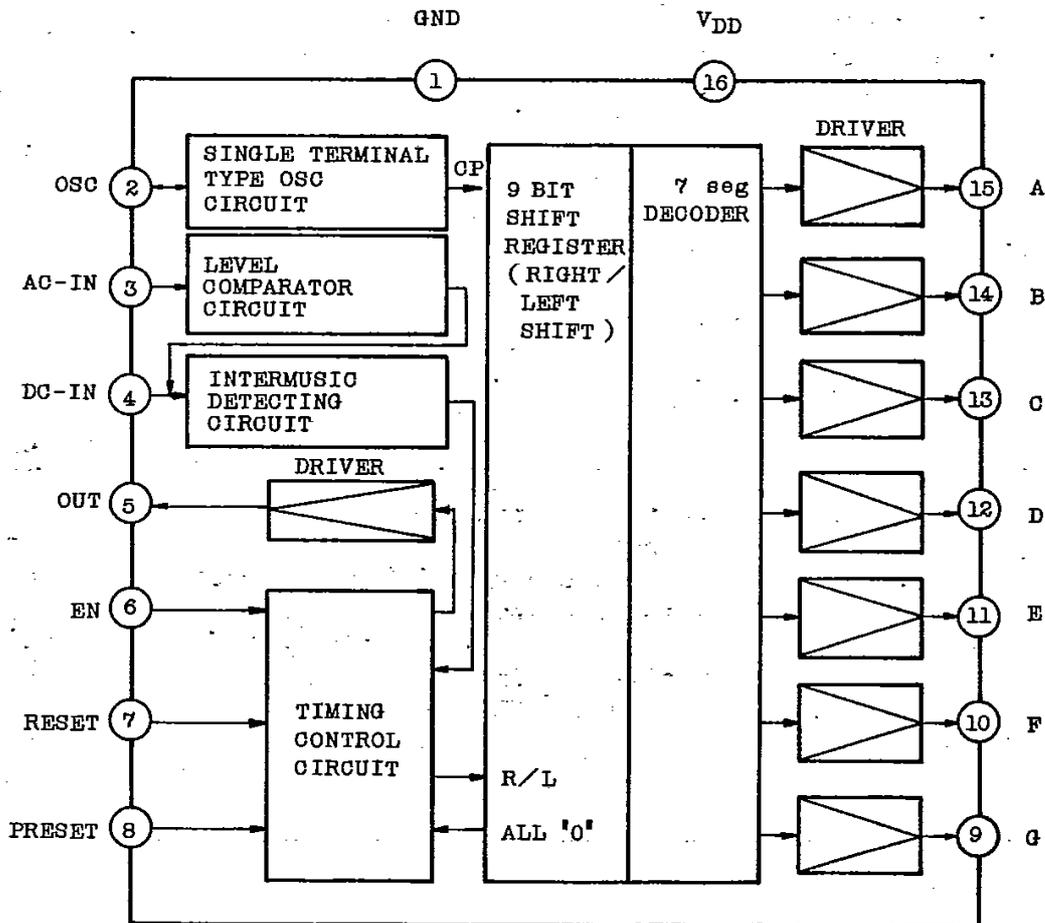
FUNCTIONAL DESCRIPTION OF EACH TERMINAL

| PIN No.	SYMBOL	FUNCTION	I/O FORM
1, 16	GND, V_{DD}	Supply voltage applying terminal	
2	OSC	The single-terminal type oscillator terminal. Frequency is set by externally connected C and R. By this frequency, the following time and pulse width are decided. 1. Preset input chattering preventing time. 2. OUT-2 output pulse width.	
3	AC-IN	The audio signal input terminal. An inverter type amplifier and a level comparator are built in, and when coupled with a capacitor, AC signal is directly inputted.	
4	DC-IN	The intermusic time setting terminal. An intermusic time can be set as desired by externally connected C and R. When an external rectifier circuit is used, a set time is input by DC signal from this terminal.	
5	OUT	The mechanical control output terminal. (Bipolar output) When the cue operation ends, pulse output ("H" level) is generated. The cue operation is stopped by this output, and the mechanism is changed over to the playing operation.	
6	EN	The intermusic detecting operation inhibiting input terminal. (C-MOS input) When this terminal is placed at "L" level, input from DC-IN (4-Pin) is made invalid. Malfunction can be prevented by inputting a "L" level signal externally at time of the mechanical changeover. When not used, "H" level signals are applied.	

TOSHIBA

| PIN No.	SYMBOL	FUNCTION	I/O FORM
7	RESET	The internal reset input terminal (with a pull-up resistor). When this terminal is placed at "L" level, the reset is made and all the 7-segment outputs (A to G) go to "L" levels. When this terminal goes to "H" level from "L" level, "0" is displayed. This terminal can also be used a preset music cancelling input.	
8	PRESET	The desired music preset terminal (with a pull-up resistor). This terminals is an input to preset a desired cue music and one music is picked up by one push. After nine pushes set the ninth music another push sets the first one and so on. (The chattering preventing circuit is built in). $0 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 4 \rightarrow 5 \rightarrow 6 \rightarrow 7 \rightarrow 8 \rightarrow 9$	
9	G	7-segment LED driver output terminals (Bipolar outputs) The outputs A to G, are capable of directly driving the cathode common LEDs. The displaying forms of characters are as follows:	
10	F		
11	E		
12	D		
13	C		
14	B		
15	A		

TC9167P

DESCRIPTION OF OPERATION

1. OSC CIRCUIT

The OSC terminal (PIN 2) is a single-terminal type oscillation circuit which oscillates with externally connected C and R.


$$f_{OSC} \approx 1.8/R_X \cdot C_X \text{ (Hz)}$$

However, use at $R_X > 12k\Omega$
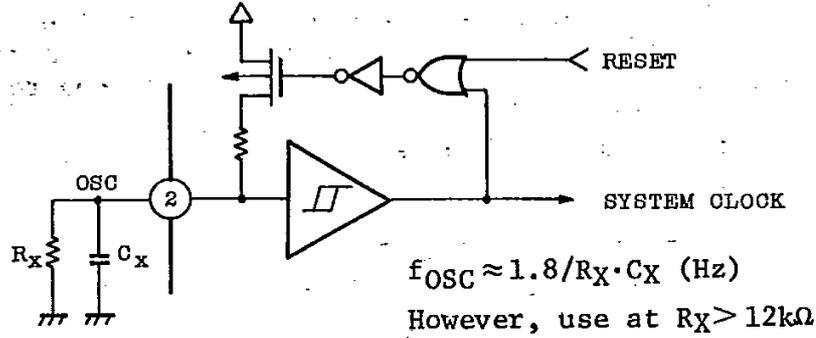
. Oscillation frequency may vary depending upon fluctuation by IC and supply voltage. (See Graph-(1).)

. Assuming that oscillation frequency is f_{OSC}, the following time and pulse width are decided.

    a. PRESET input terminal chattering preventing time : $t = 2 \sim 4 \times 1/f_{OSC}$

$$= 10 \sim 20 \text{ms} \ (f_{OSC} = 200 \text{Hz})$$

    b. OUT output terminal pulse width : $T = 8 \times 1/f_{OSC}$

$$= 40 \text{ms} \ (f_{OSC} = 200 \text{Hz})$$

2. INTERMUSIC DETECTING CIRCUIT

Audio signal from IN-1 terminal is amplified by the amplifier (20dB), and after full-wave rectification by the level comparator, transmitted through DC-IN. The intermusic time is decided by discharge time constants of C and R connected to DC-IN.


TOSHIBA

(a)
AUDIO SIGNAL

V_DD

H COMPARATOR

1/2 V_DD

L COMPARATOR

GND

(b)
H COMPARATOR
OUTPUT

(c)
L COMPARATOR
OUTPUT

(d)

V_DD

V_IH(2)

DC-IN
(4 PIN)

V_IL(2)

GND

(e)
INTERMUSIC
SIGNAL

(CUE)

(PLAY)

Tm
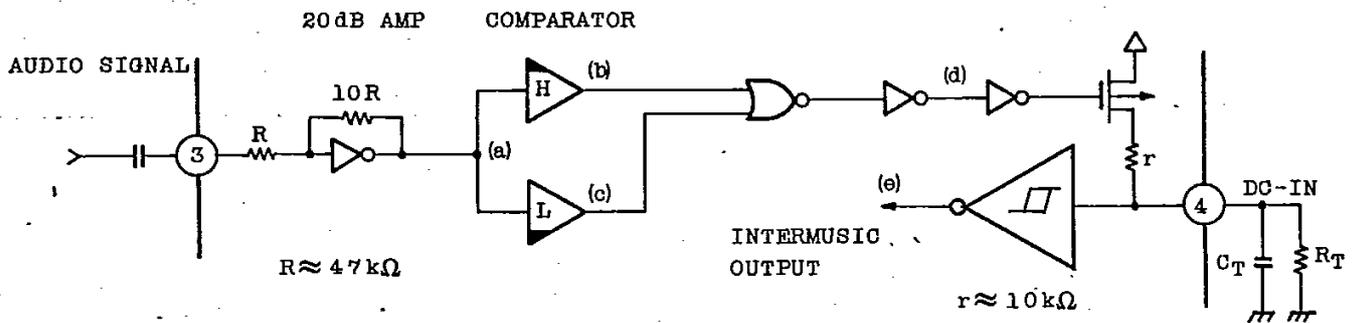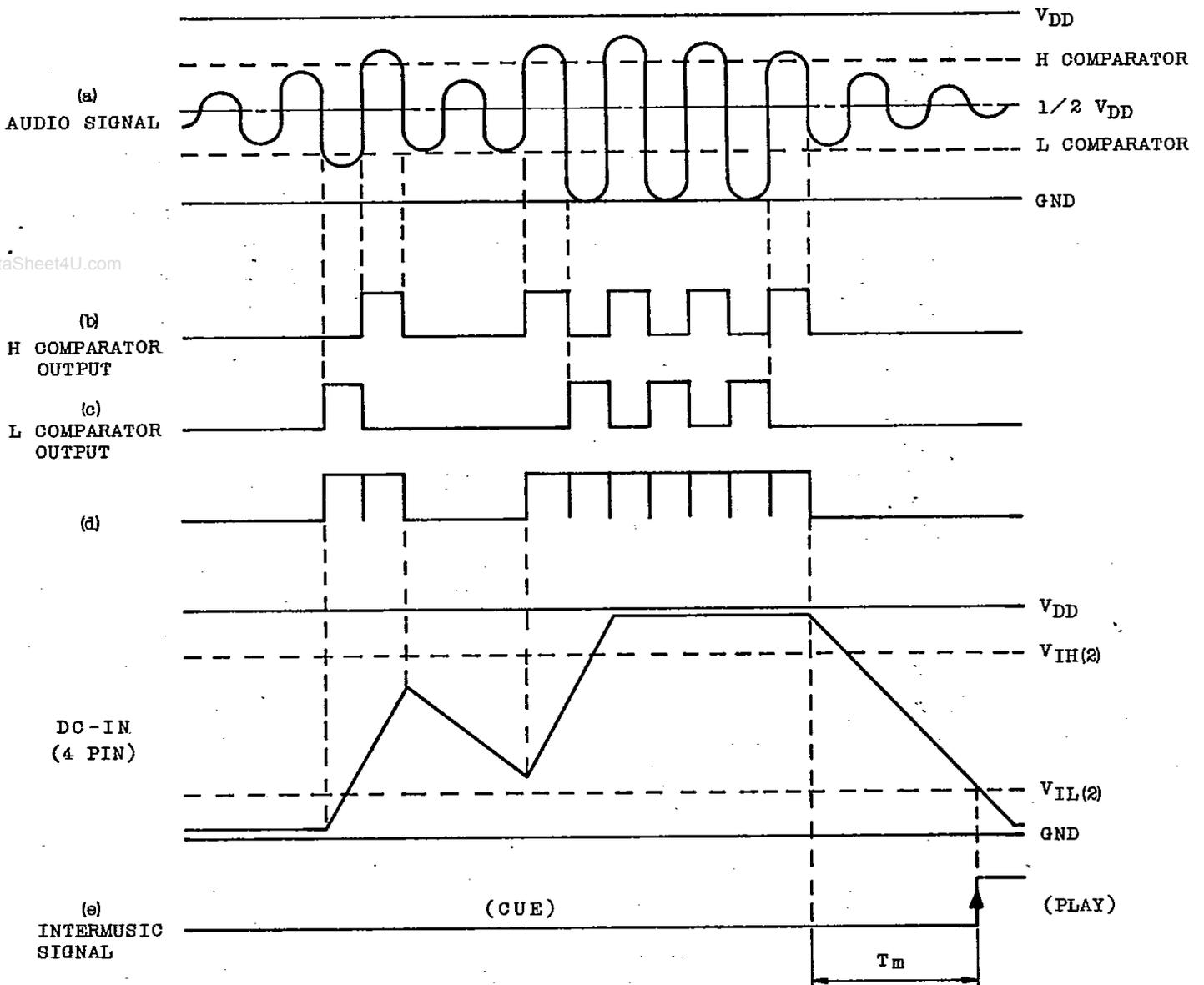
Note : H comparator level ≈ 2/3 V_DD
       L comparator level ≈ 1/3 V_DD

. Intermusic time Tm ≈ 1.5 CT·RT (sec). However, use at RT > 150kΩ.

. Intermusic time and input sensitivity may vary depending upon fluctuation by IC and supply voltage. (See Graph-(2) and (3).)

. Pulse noise between musics is prevented by output resistance (r) of DC-IN and charging time constant of CT.

3. CUE OPERATION TIME (PRESET MUSIC 5)

AUDIO SIGNAL

DC-IN TERMINAL

EN TERMINAL

INTERMUSIC JUDGEMENT

OUT TERMINAL

DISPLAY

OPERATION

CUE OPERATION
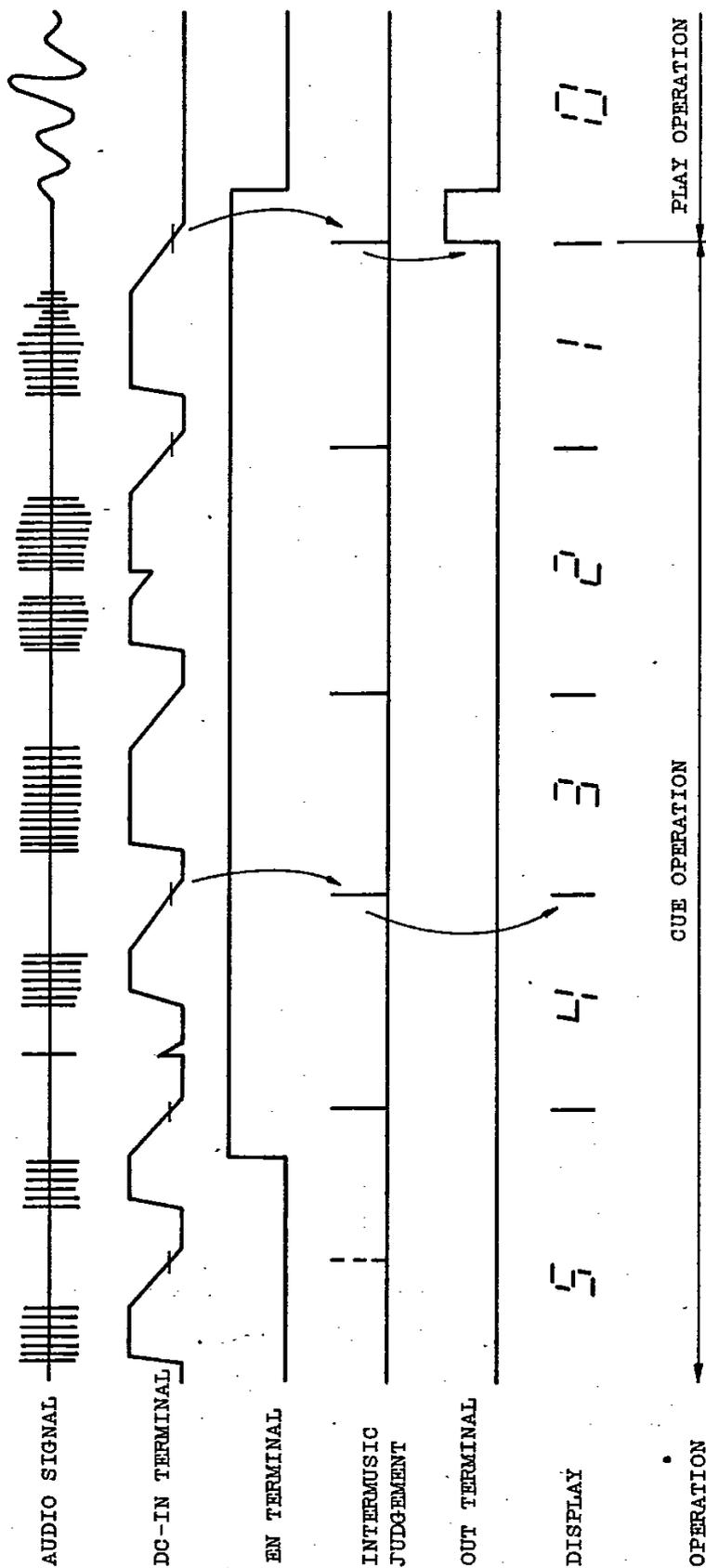
PLAY OPERATION

Note 1. As long as the EN terminal is at "L" level, the intermusic judgement becomes invalid and downcount of preset musics is not taken place.

2. Even during the cue operation, a desired music can be changed by the PRESET input.

APPLICATION CIRCUIT

V_{DD} 3～6 V

* $C_{IN} > 0.01 \mu F$, $C_L > 0.01 \mu F$
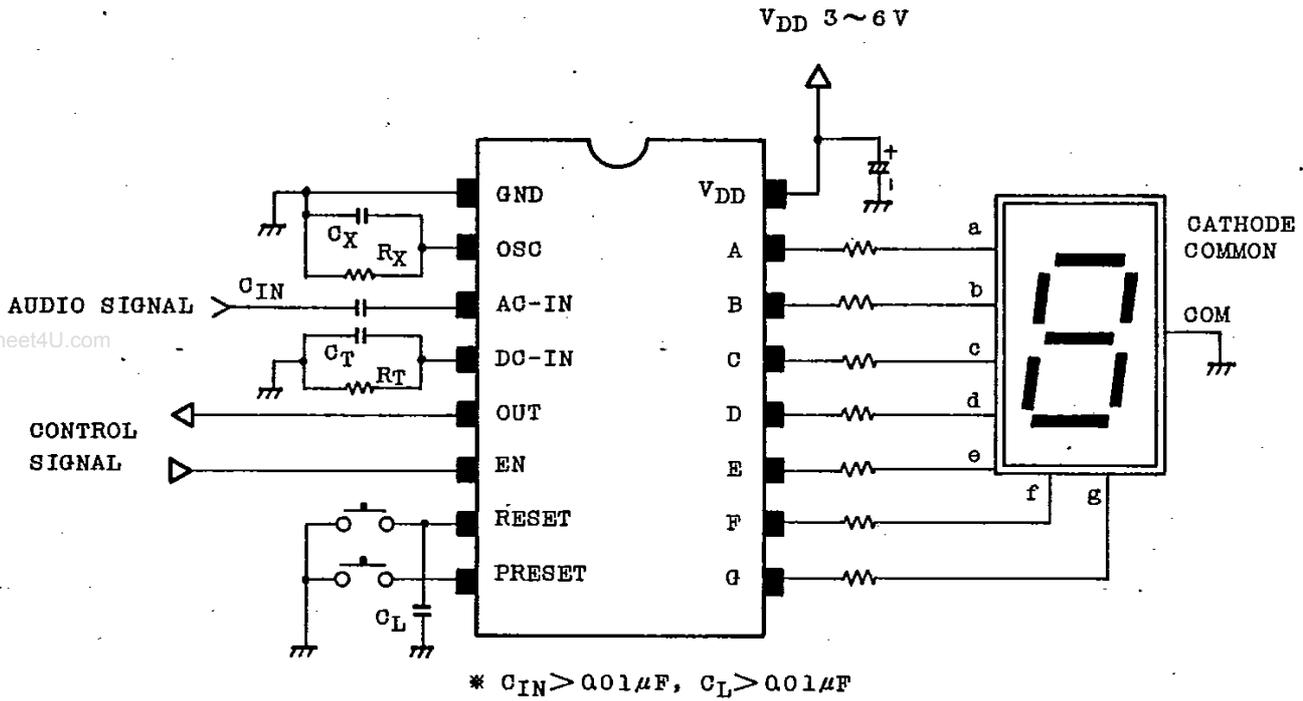
1. When an external rectification circuit is used.

0.1～0.47μF

AC-IN

DC SIGNAL ▷ ── DC-IN
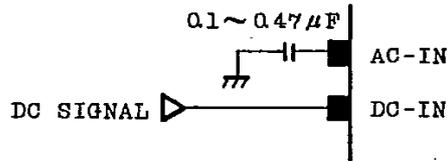
2. When display is flashed during the cue operation (at time when EN="H")

CATHODE COMMON LED

2SC1815 etc.

12kΩ

2MΩ

f≈2Hz

0.1μF
(TC4011BP)

AUDIO DIGITAL IC

TC9167P

$f_{OSC} - C_X$

$V_{DD} = 5.0 V$

$R_X = 2.2 k\Omega$

$47 k\Omega$

$100 k\Omega$

f_{OSC} (Hz)

C_X (μF)

$f_{OSC} - R_X$

$V_{DD} = 5.0 V$

$C_X = 0.1 \mu F$

$0.18 \mu F$

$0.47 \mu F$

f_{OSC} (Hz)

R_X (kΩ)

$f_{OSC} - V_{DD}$

$R_X = 4.7 k\Omega$

$C_X = 0.18 \mu F$

f_{OSC} (Hz)

V_{DD} (V)

TEST CIRCUIT

V_{DD} ⑯

OSC ② f_{OSC}

C_X R_X

GND ①

TOSHIBA

— 380 —
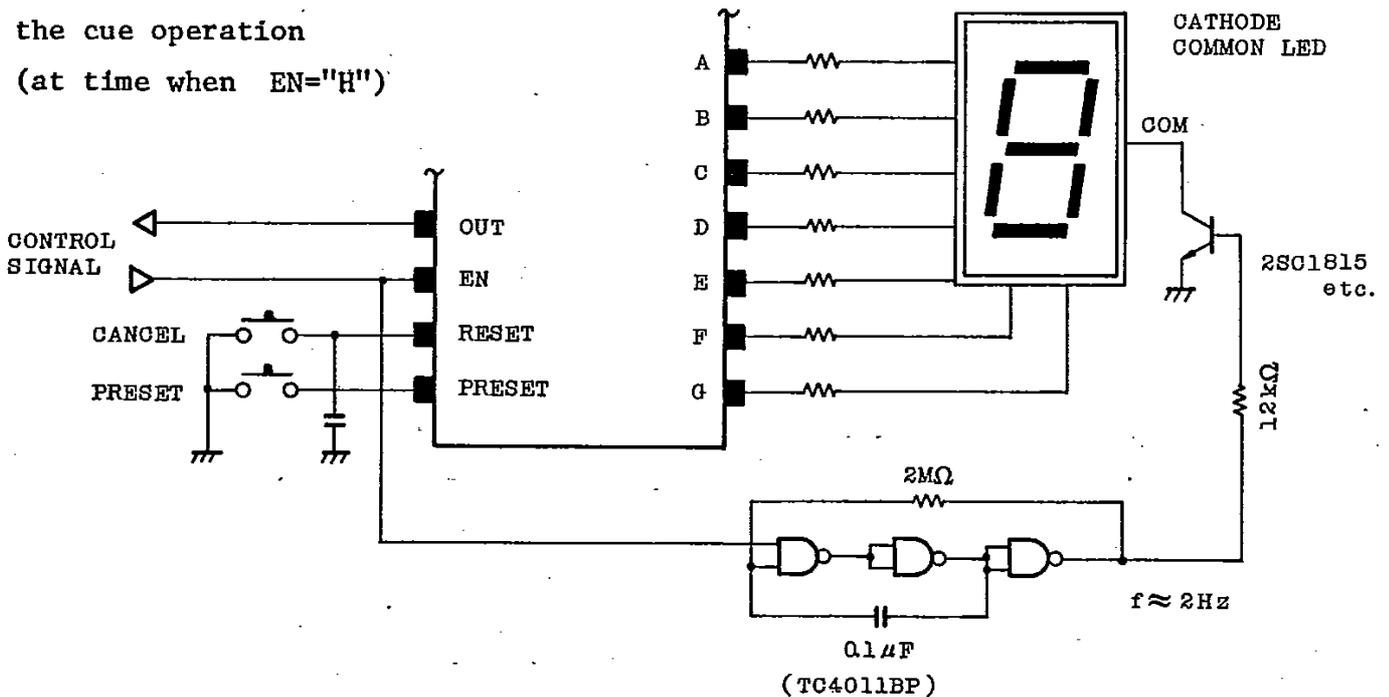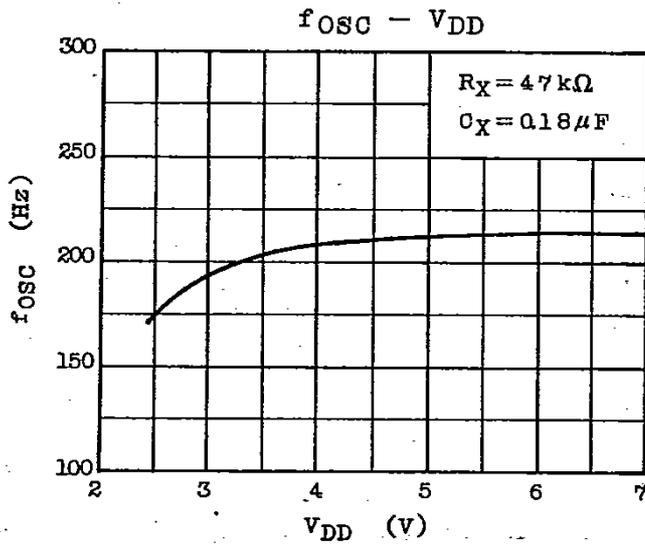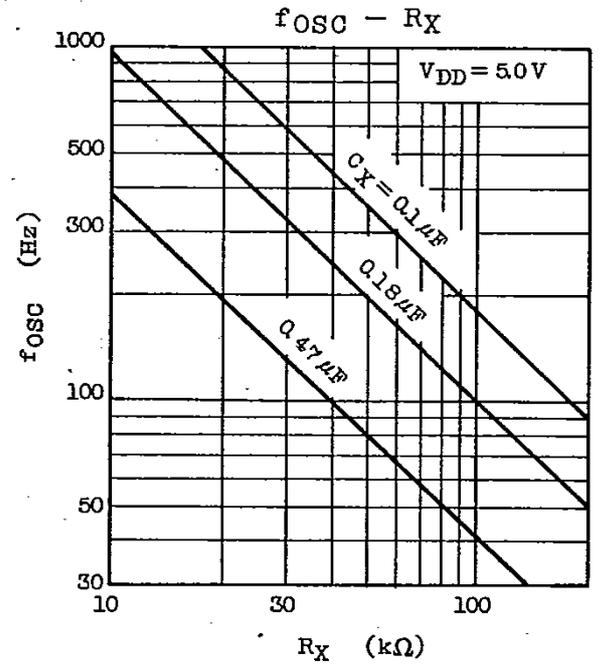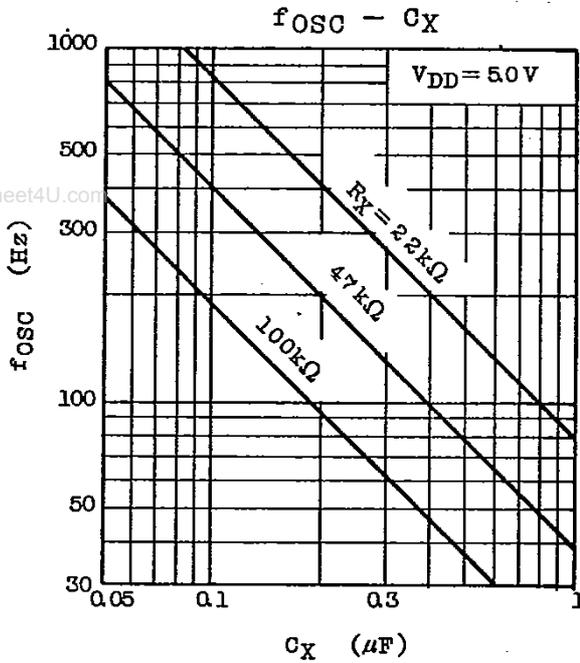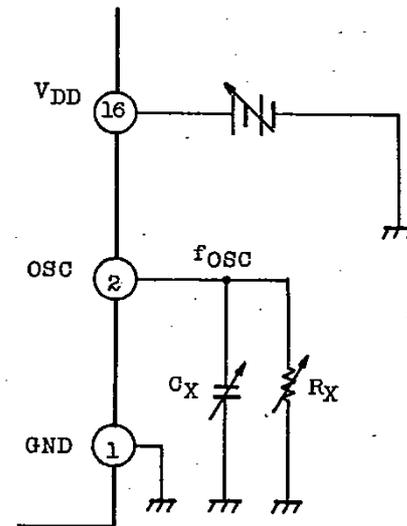
GRAPH (2)   INPUT SENSITIVITY (V_{IN}) CHARACTERISTICS   (TEST CIRCUIT-3)

$V_{IN} - V_{DD}$

$f_{IN} = 10\,kHz$

INPUT SENSITIVITY $- f_{IN}$

$V_{DD} = 5.0\,V$
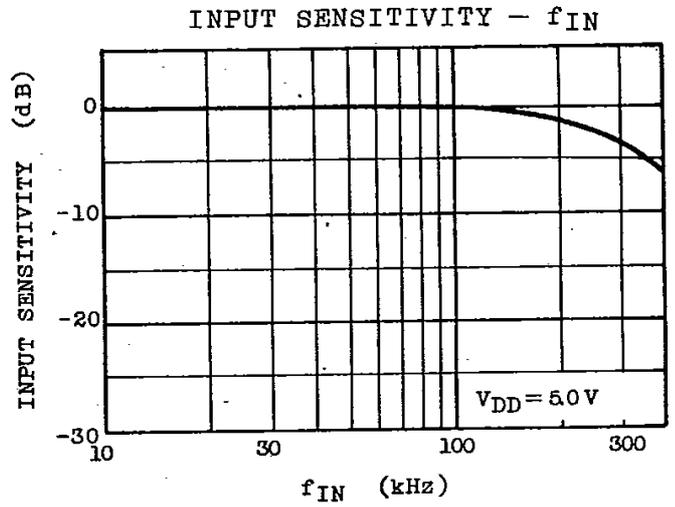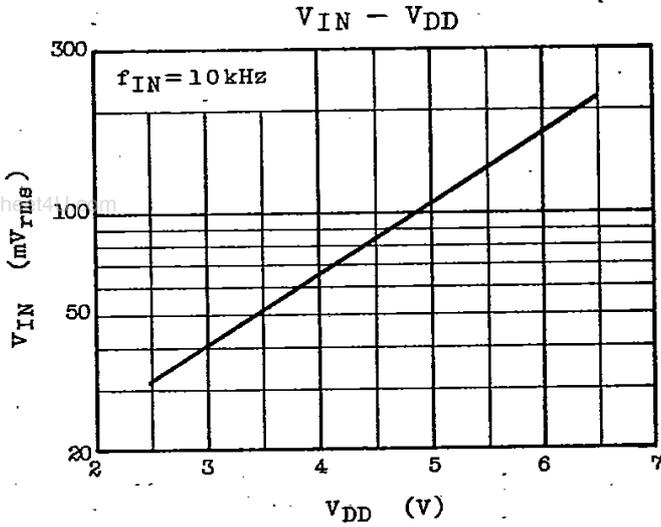
GRAPH (3)   INTERMUSIC TIME CHARACTERISTICS

$Tm - C_T$

$V_{DD} = 5.0\,V$

$R_T = 470\,k\Omega$
$330\,k\Omega$
$220\,k\Omega$

$Tm - V_{DD}$

$R_T = 470\,k\Omega$
$C_T = 0.47\,\mu F$